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Empirical insights into the benefit from implementing smart contracts

(Full Paper)

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ABSTRACT

Smart contracts are highly relevant due to their support for new decentralized business models and processes. We empirically investigate the benefit of implementing smart contracts. Our approach measures the benefit by capturing the impact of implementing smart contracts on processes directly. Thus, our research supersedes previous research that uses deductive approaches for deriving beneficial effects from technical and architectural properties of smart contracts and blockchains. We conduct a systematic approach using the aspects cost, quality, time and flexibility, and their impact on the four process phases interest, agreement, fulfillment, and assessment. Our research enables decision-makers to make decisions on implementing smart contracts more precisely. Furthermore, decision-makers become able to develop more target-oriented initiatives.

Keywords: Smart contracts, benefits, empirical investigation

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INTRODUCTION

Smart Contracts are automated and self-enforcing digital contracts (Cong & He, 2018). They are considered as the most transformative blockchain application due to their decentralized intermediate less architecture (Iansiti & Lakhani, 2017). Currently, many enterprises are implementing smart contracts. For instance, the European insurance company AXA is using smart contracts for their automatic flight compensation insurance “Fizzy”. There are several further use cases like in logistics (Casado-Vara et al., 2018) to avoid intermediaries and speed up activities, etc. Their very first idea was developed by Szabo (1997). In general, smart contracts represent contracts in software (Peck, 2017) that can be executed directly. They built up trust without using intermediaries as third parties (Tapscott & Tapscott, 2016). Furthermore, smart contracts enable the definition of conditions that are tested and trigger actions when fulfilled (Peck, 2017). In this way, participants who have agreed upon conditions store them as smart contracts, and once the conditions are met, actions defined in the smart contract are automatically executed (Ølnes, Ubacht, & Janssen, 2017).

Smart contracts receive huge attention due to their potential to implement ledgers, which are central to many economies, in a completely new way (Casey & Vigna, 2018). Application areas for smart contracts are identified in several research projects, e.g., in supply chain management (Casado-Vara et al., 2018), trade finance (Cong, 2018), food supply chain (Russo, 2018), distributed cloud computation (Cong, 2018), tourism (Calvaresi et al., 2019; Schumacher, 2019), e-commerce (Ramachandiran, 2018), additive manufacturing (e.g., Schmidt et al., 2019) agriculture (Samaniego-Cobo et al., 2018), finance (Rosati & Čuk, 2019), lifecycle of used cars (Zavolokina, Miscione, & Schwabe, 2019) and service systems (Seebacher & Schüritz, 2017). Furthermore, the OpenLaw project (OpenLaw, 2019) intends to automate legal agreements, such as freelance contracts that automatically trigger a payment when the contract’s conditions have been met. Furthermore, Smart contracts are used to enforce license terms and dispense payments (Dutra, Tumasjan, & Welpe, 2018). According to current research (e.g., Möhring et al., 2018; Risius & Spohrer, 2017), the benefit of implementing smart contracts is important for research and practice. For instance, Felin and Lakhani (2018) argue that companies have to understand the benefit from blockchains and smart contracts to configure, design, and use them in unique ways and thus providing a strategic advantage. Because it is not possible to outsource strategy definition (Felin & Zenger, 2018), research on the benefit of smart contracts and influencing aspects is essential to firms.

Based on different published research literature reviews (e.g., (Bermeo-Almeida et al., 2018; Casino, Dasaklis, & Patsakis, 2019; Grover, Kar, & Ilavarasan, 2018; Hawlitschek, Notheisen, & Teubner, 2018; Mohanta, Panda, & Jena, 2018; Yli-Huumo et al., 2016)) and on an own extended, systematic literature review according to Webster and Watson (2002) in leading databases such as AISeL, SpringerLink, ScienceDirect, IEEE Xplore regarding related smart contract keywords, there is sparse empirical research about the benefit of implementing smart contracts (e.g, Möhring et al., 2018). Often research focuses on system issues and not on application considerations (Yli-Huumo et al., 2016). Nevertheless, an understanding of the benefit of smart contracts and its influencing aspects are necessary (Felin & Lakhani, 2018) to develop adequate information systems strategies and related research foundations. Therefore, this paper focusses on the benefit of implementing smart contracts and their influencing aspects. The overall research question of our paper is the following: *Which aspects influence the benefit of implementing smart contracts?*

Our contribution is fourfold:
1.We directly and empirically determine the benefit of implementing smart contracts superseding the indirect approaches that deduce the benefit from technological and architectural properties.

2.We use a systematical approach by creating a raster for capturing the benefit using the aspects cost, quality, time and flexibility and the four process phases interest, agreement, fulfillment, and assessment.

3.By creating this raster, we provide an enumeration of alternative for the initiative on smart contracts and support thus the development of methodologies.

4.We increase the quality of decisions of firms on implementing smart contracts.

In the following section, we will first discuss the theoretical background of smart contracts. In the section research design, we describe our research methods and develop four hypotheses that will be tested later on. Subsequently, we describe our research method how we collected data. Finally, we present the results of our research.

THEORETICAL BACKGROUND

Smart contracts had been conceptualized independently from blockchains (Szabo, 1997). However, the capability of blockchain infrastructures to transfer digital assets, such as cryptocurrencies, has led to the two concepts often being considered together. Using blockchains as foundations, smart contracts are defined in formal languages that can be executed by using blockchain technology (Möhring et al., 2018). The basis for the automation in smart contracts are blockchain technologies such as Ethereum (Buterin, 2014) which contain Turing-complete programming languages. By combining this mechanism with a cryptocurrency (Nakamoto, 2008) programs that handle money are created (Narayanan & Clark, 2017). In this way, smart contracts containing such rules enable the transfer of digital assets (Buterin, 2014). To achieve privacy in public blockchains, approaches such as (Kosba et al., 2016) were developed.

It is important to note that early Blockchain Technologies do not have Turing-complete languages. For instance, Bitcoin scripting language has only 256 instructions of whom many are disabled and reserved (Wang et al., 2018). Therefore, using blockchain technologies does not imply the ability to create smart contracts (Mills et al., 2016).

In their core, smart contracts are automatically executed agreements between parties. For instance, a smart contract between a train operator and a client could define the payment for the ride and rules on how to handle reductions if the train is delayed. Smart contracts are written down in a semi-formal language that is executed automatically (Wang et al., 2018). The execution of smart contracts is decentralized (Wang et al., 2018). Each participant uses his virtual machine to execute smart contracts. The virtual machine isolates the execution of smart contracts from specifics of the underlying platform and makes the smart contracts platform agnostic. Therefore, a smart contract can be executed on different hardware and operating system platforms without change. The decentralized execution is the foundation for a distributed consensus model (Wang et al., 2018). The determination what is considered as truth is not done by a central intermediary but by the consensus of the participants.

The agreements in smart contracts can be described by rules of the form event – condition – action (Möhring et al., 2018; Szabo, 2016). In the example of a smart contract for train tickets, an event-condition-action rule could be: if the train arrives (event) and the train is punctual (condition) charge the full fare to the client's credit card (action). If a certain event arises and the defined condition is met, an action is executed. Events may be internal or external (Cong & He, 2018). Internal events originate from within the virtual machine, e.g., from the execution of the same or other contracts. External events originate from the outside of the virtual machine. To prevent fraud external, events a cryptographically signed that means a signature makes it possible to discern true from false events. Conditions are used to filter and differentiate the reaction to events by triggering an action only on the fulfillment of the condition (Cong, 2018; Szabo, 2016). Furthermore, conditions may be used to differentiate the reaction to events by choosing one or several actions depending on the fulfillment of one or several conditions. The actions specified in the event condition action rules specify either the change of variable or the transfer of digital assets.
A challenge for smart contracts is trustworthy sources for events and data. They are called "oracles" (Cong & He, 2018). Without "oracles" fraudulent events and data could be used to gain financial advantages. For instance, by providing an incorrect arrival time of a train, a compensation payment could be fraudulently triggered.

Contrary to existing research on the benefit from smart contracts, which uses a deductive approach, we measure benefit from cost, quality, time, and flexibility aspects and use a process-oriented view. We apply an empirical method by interrogating experts. Based on technical and architectural properties, potential impact aspects on the benefit of smart contracts are identified but not

quantified in the research from Wang et al. (2018), Ølnes et al.(2017), Alexopoulos et al. (2019), Karamitsos et al. (2018), and others.
The identity of contract specification and implementation denotes that the contract defined using a semi-formal language can be directly executed on a multitude of platforms. The contract is represented as program code (Tapscott & Tapscott, 2016). Thus, there is no effort necessary to transform a natural language specification into software. The direct execution also avoids errors during this transformation.

Decentralized consensus has been identified as the central mechanism of smart contracts (Cong & He, 2018). Also, Abadi and Brunnenmeier (2018) identified decentralization as technical benefit of smart contracts. Smart contracts provide a means for reaching consensus and coordination using a decentralized, peer-to-peer oriented approach (Atzori, 2017). The decentralized consensus increases resiliency and reduces the rent extracted by third parties (Cong & He, 2018). Decentralization avoids single points of failure and reduces cost by omitting centralized third parties (Cong, 2018). Casado-Varo et al. (2018) use smart contracts to avoid intermediaries and fasten up logistics. Already by Möhring et al. (2018) automation has been identified as characteristic of smart contracts. Automation means that smart contracts execute tasks, decisions, and the sensing of events without human intervention. After the execution of one task, the following one is executed automatically. Decisions are made without delays by the involvement of human decision makers. Upon events, the smart contract can react automatically.

Another technical benefit is correctness. Smart Contracts take the idea of blockchains to put data in a secure ledger and extend it into computation (Narayanan & Clark, 2017). In this way, a consensus protocol for the correct execution of a publicly specified program is defined (Narayanan & Clark, 2017). They are based on tamper-proof consensus on contingent outcomes (Cong & He, 2018). Correctness as technical benefit is confirmed by Abadi and Brunnenmeier (2018). Correctness embraces both static and dynamic aspects. The static correctness of contracts and their execution history means that contract and the logs documenting their execution cannot be altered. The dynamic correctness means that only actions are executed, which are in conformance with the rules defined in the contracts. Smart contracts assure that the overall system moves from one correct state to another only.

The transparency of smart contracts means that both the contracts and the transaction history are transparent to all stakeholders and auditable (Atzori, 2017; Tapscott & Tapscott, 2016). By this mean a single source of truth is created. Huge documentation as with previous approaches is avoided (Möhring et al., 2018). Smart contracts and their execution are resilient (Gervais et al., 2016). Due to replication and redundancy, the failure of single participant nodes does not hamper the execution of smart contracts. This is achieved by using a distributed architecture in combination with a scale-out approach (Ferdman et al., 2012). The distributed system created is more resilient and scales better (Ferdman et al., 2012). In the same way, the loss of single nodes containing contract definitions and execution logs do not endanger the availability.

Some isolated pieces of research also address the direct impact of implementing smart contracts. For instance, efficiency was identified as important advantage of smart contracts by Cong (2018). Cost and reliability were identified by Ølnes et al.(2017). Alexopoulos et al. (2019) investigated quality and flexibility. However, none of the former studies used a quantitative approach. Instead, qualitative investigations were used to derive the benefit. Therefore, a lack of empirical evidence on the benefit of smart contracts exists. It has been confirmed by Fan et al. (2018). The further development of smart contracts is documented by Narayanan and Clark (2017).

Research Design

In general, the benefit of implementing smart contracts can be defined as the "individual perceived capability of using and implementing smart contracts" (Möhring et al., 2018; Schmidt et al., 2015). For the investigation of the benefit of smart contracts and its influencing aspects, we focused on knowledge resulting from previously published research (Webster & Watson, 2002). In general, smart contracts are used to support cross-organizational business processes (Grefen et al., 2000). Cost, quality, time and flexibility as important aspects of business processes. To take a deeper look into these aspects of smart contracts, we must differentiate the phases of a (smart) contract process. Therefore, we used the research of the phases of business processes of Goldkuhl (1998). Hence, we differentiate four phases: The interest phase, the parties exchange information on their offerings, the agreement phase, and the parties commit to a contract. The obligation of the contract such as delivery and payment are part of the fulfillment phase. In the assessment phase, the fulfillment of the agreement by the other parties is evaluated, and potential claims for compensations are defined.

Using this two-dimensional raster (Figure 1), the benefit of smart contracts can be associated in the first dimension with an aspect such as cost, quality, time and flexibility and with one or several phases in the second dimension such as interest, agreement, fulfillment, and assessment. Cost, quality and time are conflicting goals for optimizations according to Gardiner (Gardiner & Stewart, 2000). It has been extended by flexibility as fourth conflicting goal (Dumas et al., 2018).

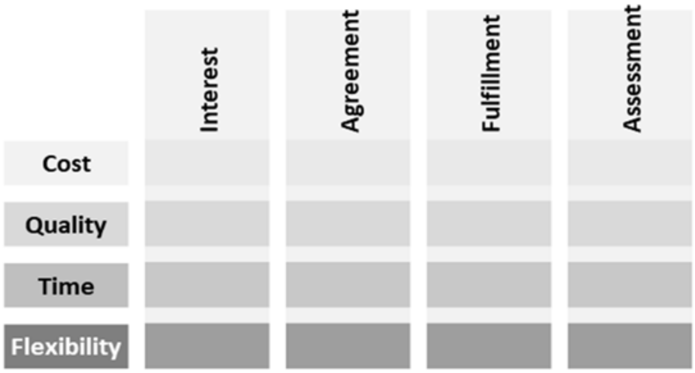

Figure 1: Two-dimensional raster for capturing the benefit from implementing smart contracts

The groundwork for capturing the cost benefits of smart contracts can be found in the transaction cost economics (Coase, 1937) and transaction cost theory (Williamson, 1979). Transaction cost is defined as the additional cost when using market-based instead of hierarchical coordination (Malone, Yates, & Benjamin, 1987). Transaction cost influences make-or-buy decisions (Walker & Weber, 1984) in the way that reducing transactions cost facilitates the use of external resources and thus increases the options for resource supply (Poppo & Zenger, 1998). In this way, new types of economic organization and governance are enabled. We assume that cost during the process of a contract positively influence the benefit of implementing smart contracts. Therefore, we formulate the hypothesis H1:

H1: Cost aspects positively influence the benefit resulting from implementing smart contracts.

In general, quality is the conformity of defined and real result of a process (Dumas et al., 2018). This includes both functional as non-functional properties such as the fulfillment of Service-Level-Agreements (Grigori et al., 2001). A process good in quality produces results by optimizing one or more quality features (Krogstie, 2016). High process quality is important to avoid negative impacts on the reputation and to avoid lost revenue, cost for damages, and contractual penalties (Dumas et al., 2018). Also, the additional processes necessary to compensate for a lack of quality can be very resource intensive. First indications for the positive impact of smart contracts and blockchains on quality, in particular, supply chain quality is given by Chen et al. (2017). Therefore, we define our hypothesis H2:

H2: Quality aspects positively influence the benefit resulting from implementing smart contracts.

The impact of time aspect on the benefit of smart contracts has been identified by Mohanta et al. (2018). Time impacts the benefit of smart contracts both on the schema and the instance level (Dumas et al., 2018). On the schema-level reductions in the time needed for adapting contracts helps to adapt it more quickly to changed requirements. Especially, the conditions of the contract can be adapted more closely to the actual market conditions. Furthermore, the reduction of time needed to run through the phases of the process instance is beneficial according to Dumas et al. (2018), Reijers and Mansar (2005) and Kohlbacher (2010). Furthermore, less time is needed; the reaction time to external events is shorter. Based on this, we suggest that improved quality of the contracting processes influence the benefit of implementing a smart contract positively. Therefore, we defined hypothesis H3:

H3: Time aspects positively influence the benefit resulting from implementing smart contracts.

Flexibility may embrace different perspectives such as the definition of task and rules, the assignment of task and data structures (Regev, Soffer, & Schmidt, 2006). It is necessary to cope with situations that cannot be prescribed, and business changes (Nurcan, 2008). Flexibility includes both parametrization and configuration (Dumas et al., 2018). Flexibility is impacting the benefit of smart contracts, according to Alexopoulos et al. (2019) and Korpela et al. (2017). Therefore, we assume the following influence in hypothesis H4:

H4: Flexibility aspects positively influence the benefit resulting from implementing smart contracts.

The conceptual research model is summarized in the following Figure:

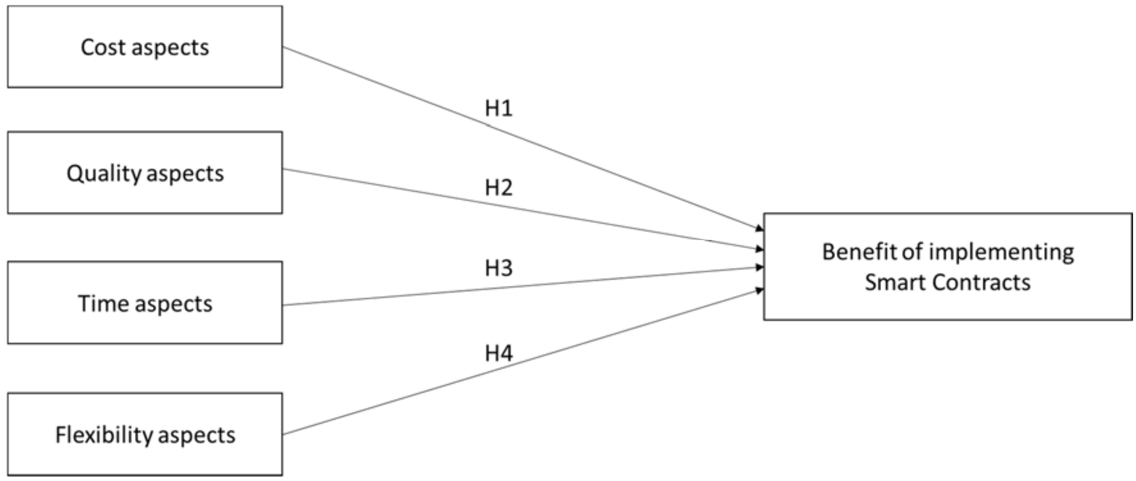

Figure 2: Research Model

Research Method and Data Collection

For the implementation of our research design, we have chosen a quantitative research approach regarding the recommendations of the current scientific literature (Recker, 2013). We used a web-based expert online survey for collecting the needed empirical data. The questionnaire was implemented via the web-based tool LimeSurvey. Questions discovering our research model were designed using a five-point Likert scale (e.g., statement questions from 1: “totally disagree” to 5: “totally agree”). The questions/items for each aspect are resulting from the identified related literature (e.g., Dumas et al., 2018; Möhring et al., 2018). The individual aspects of our conceptual research model were evaluated through different items. For instance, we asked questions (items) on 1) the overall benefit of implementing smart contracts, 2) the individual benefit of implementing smart contracts in the enterprise of the expert, 3) the effort related to the benefit of implementing, and 4) the usefulness/ease of use of implementing smart contracts. For the quality, cost, time and flexibility aspect items we asked questions related to the aspects of smart contracts of the related important process phases of a contract based on Winograd and Flores (1986) and Goldkuhl (1998). Furthermore, questions regarding the working experience and knowledge, impact of smart contracts to different areas, enterprise background of the experts as well as, e.g. gender were asked.

To reach the experts in our research field, we have contacted formal and informal the experts (e.g., via email, business social networks, contacts of the chamber of commerce, etc.). For ensuring a high quality of research, we have implemented different check-questions regarding the knowledge of our experts in the related field (e.g., knowledge and working experience in the field of smart contracts). Furthermore, in terms of the quality of our study, we run a pre-test of our questionnaire for improving it. We collected a data sample of n=108 experts in the time from October until December 2018 in German-speaking countries (Germany, Austria, Switzerland). After data cleaning (e.g., through missing data and check questions), we collected a final sample of n=71. The data formatting and cleaning process were supported by technical tools like Microsoft Excel based on .csv and .xls files. Our experts currently working in the field of smart contracts and planning or implementing them. The experts have approx. ten years of working experience in related industry sectors and working for enterprises with 31,334 employees on average coming from sectors like information and communication technology, finance, manufacturing, etc. Furthermore, n=7 of our experts are female, and n=64 are male. In general, for approx. 79% of our experts implementing smart contracts are very beneficial. Furthermore, the majority (approx. 95%) of our experts think that their current business models will be influenced by smart contracts. Business processes implementing smart contracts will be changed in the future based on the opinion of most of our experts (approx. 95%).

A structural equation modeling (SEM) approach (Hooper, Coughlan, & Mullen, 2008; Wong, 2013) was used to analyze our empirical data with our causal model. In general, the approach consists of two models (Wong 2013): the structural model (developed in the research design section of the paper, see Figure 2) and the measurement model (described by items above and criteria’s in the results section). We used a PLS approach with Smart PLS regarding the literature and our sample size as well as less empirical research in this area (Ringle, Wende, & Becker, 2015; Wong, 2013). The approach is based on the calculation of least squared regression on sumscores. We run the Java-based smart PLS software version 3.2 with the recommendations of the literature (Ringle et al., 2015; Wong, 2013). Furthermore, the level of significance was calculated via the method of bootstrapping based on the related recommendations of the literature (Wong 2013) and should be below $p<0.05$ to reach a significant level. All needed quality metrics were calculated to ensure a high quality of research. For instance, the coefficient of the determination (R^2), composite reliability, etc. are in a satisfying range (see the results section as well as Table 1). Therefore, our model ensures a high reliability according to the recommendations of the scientific literature. The used method is common in information systems research as well as recommended (e.g., Siponen & Vance, 2010). In the following, we present our empirical insights evaluating our research model.

RESULT

After analyzing our causal research model with our collected empirical data, we got the following results (Figure 3). Regarding the quality of our model, the coefficient of the determination (R^2) is with the value of 0.617 > 0.19 satisfying according to the recommendations of the literature related to Chin (1998). The other metrics of our model are shown in table 1 and are also in a satisfying, reliable range (e.g., composite reliability > 0.7 (Henseler et al., 2014))).

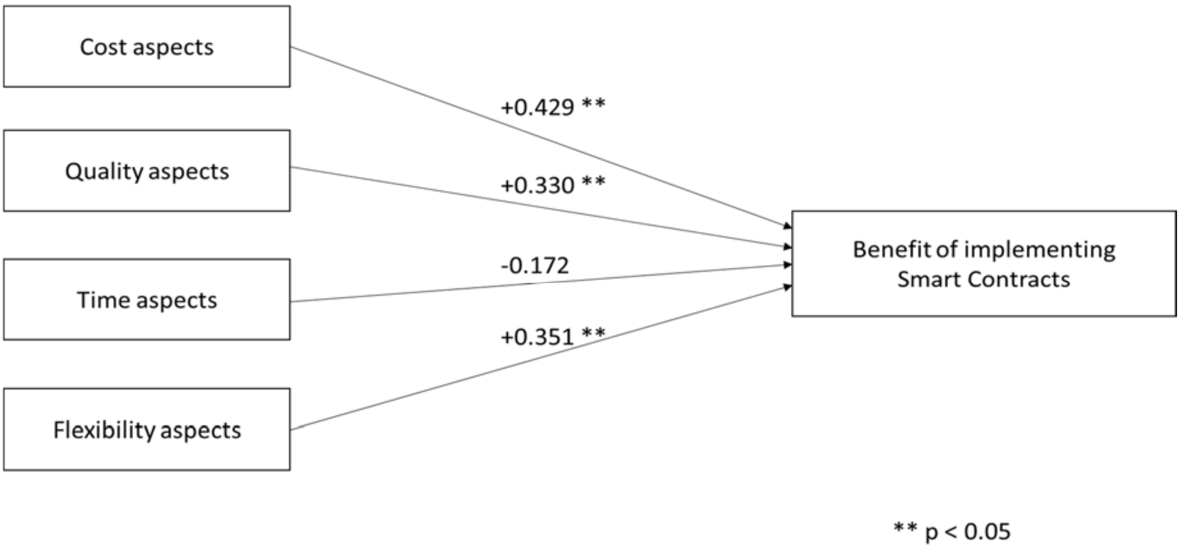

Figure 3: Results

Cost aspects

Regarding the analysis of our first hypothesis, we can support our hypothesis, because of a significant positive path coefficient (+0.429; p<0.05). Therefore, cost aspects positively influence the benefit of implementing smart contracts. The reduction of cost can be explained by several factors. First, smart contracts do not involve intermediaries that demand fees, etc. for their services (Alexopoulos et al., 2019; Beck et al., 2017; Risius & Spohrer, 2017). Second smart contracts provide a high degree of automation during all phases of the process (Casino et al., 2019; Notheisen, Cholewa, & Shanmugam, 2017; Seebacher & Schüritz, 2017). Furthermore, cost is reduced by the identity of the smart contracts with its implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Contrary to conventional contracts, now, software development is necessary to implement a smart contract. Furthermore, cost impacts the benefit from smart contracts differently in the four phases. In the interest, phase is lower than in the agreement phase, where costly intermediaries can be avoided. During the fulfillment phase, the cost for tracking and tracing the process execution can be reduced. Using smart contracts, the assessment phase can be reduced significantly, because automatic mechanisms in smart contracts and the transparency avoid situations needing disputes.

SEM-Path	Path Coefficient	Signifi-cances	Factor/ Aspect	Cronbach's α of the factor	Composite relia-bility
Cost aspects → Benefit of implementing a smart contract	+0.429	0.001	Cost aspects	0.7	0.8
Quality aspects → Benefit of implementing a smart contract	+0.330	0.007	Quality aspects	0.8	0.9
Time aspects → Benefit of implementing a smart contract	-0.172	0.239	Time aspects	0.7	0.8
Flexibility aspects→ Benefit of implementing a smart contract	+0.351	0.007	Flexibility aspects	0.9	0.9
-	-	-	Benefit of implementing a smart contract	0.8	0.8

Table 1: Rounded metrics of the results of the analysis of the structural equation model

Quality aspects

The positive influence of quality to the benefit of implementing smart contracts can also be supported by our analysis. Consequently, hypothesis H2 can be confirmed based on a significant, positive path coefficient (+0.330; p<0.05). Quality is increased because contracts and software technical implementation is one and that all contractual partners use the same implementation; thus the identity of contract and implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Previous approaches had to create software to implement the contract. Often several implementations were necessary because of different platforms at the contractual partners. Smart contracts, however, only use one contract that is the implementation for all partners and thus avoid inconsistent implementation. Also, automation contributes to quality by avoiding human interventions with a high error rate (Casino et al., 2019; Wang et al., 2018). The high transparency of smart contracts also contributes to quality (Batubara, Ubacht, & Janssen, 2018; Karamitsos et al., 2018), because it creates a single source of truth (Friedlmaier, Tumasjan, & Welpe, 2017; Zavolokina et al., 2019) and thus avoids inconsistent interpretations. Quality is also improved by the resiliency of smart contracts (Atzori, 2017; Gervais et al., 2016). Furthermore, Mohanta et al. (2018) argue, that also the higher accuracy of smart contracts can be used as an explanation. Furthermore, automation increases the quality in the contract fulfillment phase primarily.

Time aspects

Furthermore, time aspects are interesting for our experts. However, on the base of our analysis, we cannot confirm our hypothesis 3, because of a missing significance ($p=0.239>0.05$). In general, time aspects are necessary to evaluate and improve contract related processes. Research suggests that the execution time is reduced by automation implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Furthermore, another factor inside can be the speed and real-time updates (Mohanta et al., 2018). This includes the proceeding of the process and the reaction to external events. However, regarding our non-significant data, the majority of our experts might be not confident about timing aspects. Therefore, more future research and a deeper look into cost aspects are needed.

Flexibility aspects

Finally, flexibility aspects are very important for our experts regarding our data analysis. We can significantly (+0.351; $p<0.05$) support hypothesis 4. Therefore, the flexibility of smart contracts positively influences the benefit coming from implementing smart contracts. This can be explained by multiple factors. Flexibility is enabled by the ability of smart contracts to quickly implement changes due to the identity of smart contract and its implementation (Carter & Ubacht, 2018; Karamitsos et al., 2018). Thus, changes in the interest and agreement phase can be implemented directly and without running through multiple steps of an implementation process. Also, the high degree of automation in smart contracts contributes to their flexibility especially in the fulfillment and assessment phase because rules to cope with different situations can be quickly selected and executed process (Casino et al., 2019; Notheisen et al., 2017; Seebacher & Schüritz, 2017). In the following, a conclusion, as well as discussion, is given based on our research results.

CONCLUSION AND DISCUSSION

Smart contracts are important for information systems research and practice, as well (Möhring et al., 2018; Risius & Spohrer, 2017). Smart contracts will transform structures, processes, and intermediaries in firms using them (Iansiti & Lakhani, 2017). To make markets thrive, their participants have to be able to efficiently verify and audit transaction attributes (Catalini & Gans, 2016). In general, contracts are essential for firms: they are used to procure material, hire personnel, and sell goods. Therefore, technology is of huge importance that can automate the creation, definition, making, and execution of contracts. In the past, there was a lack of research about the benefit of implementing smart contracts and its influencing factors. We respond with our research to the need of more scientific work driven by past research (Möhring et al., 2018; Risius & Spohrer, 2017). Our research develops a related research model, evaluate the model through a quantitative expert study and show first empirical results as well as discussions. We found that cost, quality and flexibility aspects influence significantly the benefit resulting from implementing smart contracts.

There are several implications for research and practice based on our results. Our research extends the scientific knowledge base about the benefit of implementing smart contracts and its influencing factors. We showed empirically how strong these factors are. We extend previous research in different ways. Our research supports and extends the strategic decision making on smart contracts and decision making, identified as an important theme of research by, e.g., Felin and Lakhani (2018) and Carson et al. (2018). Furthermore, we extend the practical, driven research view of smart contracts of, e.g., Möhring et al. (2018) to more focus on the side of benefits of implementing smart contracts and its influencing factors. Also, practice can benefit from our research. Related managers can use our results to evaluate the implementation of smart contracts in their business. Different practical use cases can be compared based on different influencing factors. Furthermore, our research shows more insights into this relatively new topic for business to clarify important aspects and support decisions. Enterprise and organizations can directly determine the impact of smart contracts on their processes.

Limitations can be found in the research method and sample size. Furthermore, we selected only experts from German-speaking countries (Germany, Austria, Switzerland). However, our research approach is commonly used in information systems research (e.g. Ortbach et al., 2013; Schmidt et al., 2015) and shows interesting scientific findings. Future research can be used to cover these limitations and extend the knowledge base. For instance, comparative studies with experts from different major countries like, e.g., China and North America can be used for comparison, evaluation as well as the extension of our research. We could not address all the possible factors in our study. Therefore, there is a good opportunity to enlarge the number of factors to explain the benefit of implementing smart contracts. Furthermore, qualitative studies to evaluate implementation projects are also a good starting point for future research.

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